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CANARIAN ASTRONOMY BEFORE THE CONQUEST: THE PRE-HISPANIC CALENDAR

LA ASTRONOMÍA EN CANARIAS ANTES DE LA CONQUISTA: EL CALENDARIO PREHISPÁNICO

J. A. Belmonte[1], C. Esteban[1], A. Aparicio[1], A. Tejera Gaspar[2] and O. González[3]

(1) *Instituto de Astrofísica de Canarias, Vía Lactea S.N. 38200 La Laguna, Tenerife, Spain.*

(2) *Departamento de Prehistoria, Antropología e Historia Antigua, Universidad de La Laguna, Campus de Guajara, Tenerife, Spain.*

(3) *Museo de la Ciencia y del Cosmos, Cabildo de Tenerife, Avenida de los Menceyes S.N., La Laguna, Tenerife, Spain.*

Sumario: En este artículo se persigue un primer acercamiento al estudio de las prácticas astronómicas de los habitantes prehispánicos de las Islas Canarias. Más específicamente, vamos a tratar de estudiar el calendario en uso en Tenerife y Gran Canaria, islas en que la información existente es más abundante. Con este objetivo en mente, vamos a hacer uso tanto de las fuentes antropológicas como de los registros puramente arqueológicos (las llamadas fuentes etno y arqueoastronómicas). En la sección 1 ofrecemos una introducción, mientras que las secciones 2 y 3 se dedican al estudio de las fuentes etnográficas y arqueológicas, respectivamente. Finalmente, la sección 4 se dedica a la discusión y a describir nuestros principales resultados y conclusiones.

Abstract: In this paper, we pursued a first approach to the study of the astronomical practices of the pre-hispanic inhabitants of the islands. Specifically, we have tried to study the calendar which was in use at Tenerife and Gran Canaria, the islands where the available information is most abundant. With this objective in mind, we will make use of both the anthropological sources and the purely archaeological records (so-called ethnoastronomical and archaeastronomical evidences). Section 1 offers an introduction. Sections 2 and 3 are devoted to the study of these ethnographic and purely archaeological evidences, respectively. In section 4, a discussion of all the available information is presented, together with our conclusions.

1. INTRODUCTION.

Pre-hispanic Canarian societies do not form a homogeneous cultural context, despite of the fact they appear in the same geographical area. The islanders came very likely from the northwest of Africa and were possibly related to the *libii, maurii, getulii, maxii* or *garamantii*, ethnonyms used by Greeks and Romans when referring to the pre-roman inhabitants of this part of the continent. These populations, linguistically related to the Afroasiatic group, probably settled in the islands in an epoch not earlier than the Vth Century B.C.

Their cultural diversity may be explained, amongst other possible reasons, on the basis of a number of migrations of distinct groups throughout various epochs. This diversity is expressesd not only by the material remains, social organization and economic structure, but also –and most importantly– through several aspects of their religious world. The ecological differences between the islands (almost dessertic -e.g. Lanzarote- versus almost a paradise -e.g. Tenerife-) were also expressed by means of adaptive processes to such diverse media.

For instance, Tenerife's social and political system was characterized by a division into nine tribal territories (menceyatos). Housing was mainly in caves and small huts, and the economy was mostly based on small cattle raising and, to a lesser extent, on agriculture. Islanders employed very simple pottery, generally lacking any kind of ornaments or decorations..

Conversely, Gran Canaria presents the most evolved culture of the islands. Its hierarchical social structure resembled quite closely a proto-state. This aspect is clearly illustrated by the existence of irrigated agricultural land. Products were stocked in communal granaries, and there were a large number of tumular tombs. Houses consisted normaly of solid constructions or artificial caves, which were often painted and decorated –like pottery, much more exquisite than in any other island–. The presence of a large number of petroglyphic stations, including alphabetic, and of

religious images -small idols- has no comparison either. We will see here that these differences can also be found in the archaeoastronomical context (e.g., we found them in the different time computing systems inferred for both islands -see sect. 3-).

A slow process of cultural transformation began in the mid XIVth Century, when the islands were re-discovered by Europe. This process was reinforced by the settlement of European colonists in Lanzarote in 1402, and came to a halt with the conquest of Tenerife in 1496. This date epitomizes the final stage of the Ancient World in the Atlantic frontage of the Old World, somehow kept aside in the Canary Islands for more than 1000 years.

2. THE ETHNOASTRONOMICAL EVIDENCE.

The ethnoastronomical sources are rather scarce and they consist, mainly, of short references written by Europeans, or islanders that had become Europeanized, shortly before, during and after the conquest. Amongst the most notable of these are the "chronicles", written down mostly in the XVIth century, the most important being those of Sedeño [1], Espinosa [2], Abreu [3] and Torriani [4], dating from 1505, 1590, 1592 and 1594, respectively, or the later one of Marín de Cubas [5], written in 1694 A.D.

The aboriginal magical and religious world was connected with natural phenomena and the vegetative cycle, both intimately related to the calendar, as in other ancient cultures. The presence of astral divinities and cults was a constant in the islands. The Sun, called Magec in Tenerife [6], the Moon and perhaps other celestial bodies were worshiped as the oldest references point out (Ibn Jaldun in 1377 A.D. [7], Cadamosto in 1450 [8]). This evidence seems to have its material counterpart in some archaeological records as, for example, petroglyphs stations or the *pintaderas*. On the other hand, and most important for our purpose, studying the chronicles, it becomes obvious that the Sun and the Moon were in fact commonly used for time computing.

In Tenerife, Espinosa [9] informs us that the guanches *...hacían entre año, el cual contaban ellos por lunaciones, muchas juntas generales...* (...during the year, which they measured with lunations, made a lot of general assemblies...), and that *...Cuando hacían su agosto y recogían los panes, hacían juntas y fiestas en cada reino...* (...when they made their august and gathered their harvests, they made councils and feasts in every kingdom...). Besides, Torriani [10] wrote that *...Contaban el tiempo de la luna con nombres diferentes, y el mes de agosto se llamaba Begnesmet...* (...the time of the Moon was counted with different names, and the moon of August was called Begnesmet...). At this point, it is important to note that

the sufix smet has been related to the aboriginal ordinal number smet(ti), with the meaning of "second". Consequently, it has been suggested that Begnesmet might mean "second (moon)", however, this interpretation is far from being universally accepted [11].

As for Gran Canaria, Sedeño, who participated in the conquest of the island, tells us that the canarians ...*contaban el año por 12 meses, i el mes por lunas, i el día por soles, i la semana por 7 soles. Llamaban al año Achano. Acababan su año a el fin del quarto mes: esto es, su año comensaba por el equinoccio de la primavera, i al quarto mes que era cuando habían acavado la sementera, que era por fines de junio, hacían grandes fiestas por nuebe días continuos,* ... (...counted the year by 12 months, the month by moons, and the day by suns, and the week by 7 suns. They called the year Achano. They finished the year at the end of the fourth month: i.e., their year started at the vernal equinox, and, in the fourth month when they had finished the sowing season, which was at the end of June, they made great festivals for nine consecutive days...).

Marín de Cubas [12], almost two centuries later, repeats a similar speech, but relating the new year to the summer solstice instead of to the spring equinox. In this sense, he wrote that the canarians ...*contaban su año llamado Acano por las lunaciones de 29 soles desde el día que aparecía nueva, empesaban por el estio, quando el Sol entra en Cancro a 21 de junio en adelante, la primera conjunción, y por 9 días continuos hazían grandes vailes y convites, y casamientos haviendo cojido sus sementeras, hazían raias en tablas, pared o piedras; llamaban tara, y tarja, aquella memoria de lo que significaba...* (...counted their year by lunations of 29 suns from the day of the new moon, starting in summer, when the Sun enters Cancer from June 21st ahead, the first conjuction, and they made great dances and feasts, and marriages, for nine consecutive days, having gathered their harvests. They made scratches on tables, walls or stones, calling tara and tarja, the memory of what it meant...). It might be that the chronicler, who wrote second or even third hand, mixed information from Gran Canaria, with some scattered references about the importance of the summer solstice from all the islands like, for instance, Fuerteventura [13].

However, there is one aspect on which most of the ethnographic evidence do agree, which is the time of harvest festivals. It has been suggested [14], and seems pausible, that the differences between Gran Canaria (end of June) and Tenerife (middle of August) might be due to the different principal crops gathered on each island, barley on Gran Canaria, and wheat on Tenerife.

3. The ARCHAEOASTRONOMICAL EVIDENCES.

The archaeological records, both in Tenerife and Gran Canaria, are rather abundant but not always easy to interpret.

Although no historical references to ceremonial precincts exist in the island of Tenerife, several small sanctuaries have been identified on the top of several roques (the hard stone peaks, which remain from the erosion of volcanic cones) and, on some occasions, on the verge of very narrow high-passes between mountains, closed on each side by extremely steep cliffs, which are often termed degolladas or bailaderos. We have investigated several of these sites, but in this work, our discussion will be limited to those with a highly probable archaeoastronomical significance. Amongst them, we will concentrate on the largest and most impressive of these centres, located at the Degollada of Yeje (Masca), in the northwest of the island, and a set of precincts, with similar contexts, in the Valley of San Lorenzo (Arona), southwest of Tenerife. On the other hand, on Gran Canaria, ancient chroniclers indeed agreed on the existence of sacred precincts –often called almogaren(es)– in many settlements, and also on the summits of the most attractive mountains in the island [15,16]. In this work, we will deal with two of the most impressive of these sanctuaries: those at Roque Bentayga (Tejeda) and Cuatro Puertas (Telde).

The work has comprised the study of the rising and setting of the Sun at different epochs, in particular at solstices and equinoxes; the rising and setting of the Moon, in particular on its major and minor standstills (lunastices); and the more specific cases of the rising of the full-moon following the solstices. However, for completeness, other astronomical events, such as the rising and setting of certain stars and asterisms, have also been investigated. Every possible event has been determined considering, when necessary, the corrections for refraction, horizon depression, horizon irregularity and, in the case of the Moon, parallax. The secular effects, such as precession or ecliptic obliqueness (ϵ) variability have also been taken into account where appropriate. Most of the measurements were performed using high precision compasses, correcting for the magnetic declination at each site although, in some cases, a surveyor transit was used (see [17] for a complete description of all this phenomenology). All the measurements can be considered as well-based, since some kind of independent astronomical verification (such as the rising or setting of a celestial object) has been generally performed.

3.1. The Sanctuary at the Degollada de Yeje (Tenerife).

This sacred settlement receives different names in the literature: Roque Tarucho, Quesera de Masca, Pico Yeje, etc... [18]. However, the term we have chosen here is geographically, perhaps, the most appropriate. The sanctuary consists of a burial cave, some shepherd taros (refuges), several rock carved ritual basins, of a variety of sizes, and various petroglyph stations, extending for nearly 300 m along the edge of an 800 m high degollada, with more than 200 m high cliffs on both sides. Figure 1 illustrates the northern nucleus of the sanctuary, where three basins and a horizontal circular radial petroglyph, amongst other items, are deeply engraved on the very hard rock-bed. The petroglyph has been interpreted as a representation of the ancient inhabitants (guanche) god of the Sun, Mageb [19].

However, what is really striking is the extremely impressive and attractive horizon visible from the site. The east side is dominated by the Cumbres (Heights) of Masca, more than 1000 m high, and the presence of the highest peak in Tenerife, the still active Teide volcano, which is first visible from precisely that spot when walking south along the degollada, coming from the single easy access point. The west side opens towards the sea, where the lesser islands of Gomera and La Palma disrupt the otherwise flat horizon, providing two explendid foresights. Finally, the north and south views are occupied by the nearby mountains connected across the degollada. Incidently, three radii of the petroglyph point in the general directions of sunrise at summer solstice ($\Sigma_\odot$ hereafter), sunset at the same epoch ($\Pi_\odot$ hereafter) and sunset at winter solstice ($\pi_\odot$ hereafter), respectively. The accuracy is fine in the first case and, in the other two cases, the situation is indeed more apealling, since sunsets take place over conpicuous and very distant foresights, the highest peaks of La Palma (Roque de los Muchachos) and Gomera (Pico Garajonay), respectively, as we demonstrate in Figure 2.

On the other hand, when staying at the site, it seems obvious that the visibility of Teide from the spot must have been an important task. In this sense, it is curious to note that the August full-moon (i.e. the one of Begnesmet) rises behind Teide (covering roughly 15°) during most of the 19 year node precesion period. Whether this phenomenum was important or not, to the sanctuary owners, will be discussed later on. No clear evidence of another phenomenon of strong archaeoastronomical significance has been found at Yeje. This is not surprising since, if our interpretation were correct, the place of the sanctuary would have been chosen on the basis of three circumstances (and no others are needed, apparently): the first visibility of Teide, on one side, and $\pi_\odot$, over Garajonay, and $\Pi_\odot$, over Roque de los Muchachos, as distant foresights, on the other.

Fig. 1. The northern nucleus of the aboriginal sanctuary on the Degollada of Yeje (Tenerife). A set of three contiguous basins, perhaps for ritual offerings, and a hypothetical solar symbol are deeply engraved in the rock.

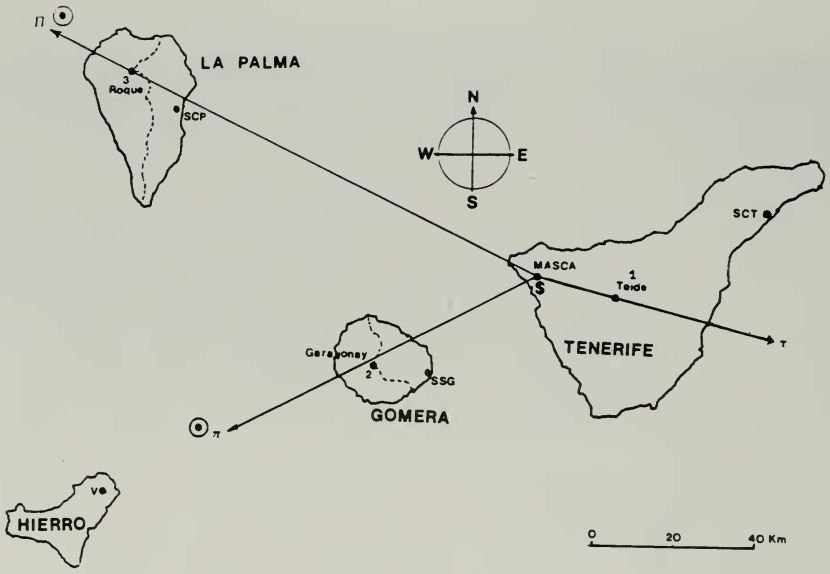

Fig. 2. The western Canary Islands, all them visible, under medium atmospheric conditions, from the Degollada of Yeje. If the archaeoastronomical interpretation were correct, the site of the sanctuary (and the Sun petroglyph), near the village of Masca (marked by a $ sign), would have been chosen as the only place on the whole island of Tenerife, where the following occur simultaneously: (1) Teide (the highest peak on Tenerife) is visible; (2) the Sun sets, in the winter solstice ($\odot_\pi$), over Pico Garajonay (1487 m, highest point of Gomera island); and (3), the Sun sets, in the summer solstice ($\odot_\Pi$), over the Roque de los Muchachos (2426 m, highest point of La Palma island). Number 4 illustrates the location of the other sites studied in Tenerife: the aboriginal centres of the Valley of San Lorenzo.

3.2. The Sanctuaries of the Valley of San Lorenzo (Tenerife).

There is one sacred enclosure in this valley which can be considered to belong to a geographycal and archaeological context similar to the one studied before. This is sited at 340 m above sea level on the north-east slope of a mountain in the centre of the valley and it is known as the ceremonial centre of Roque de la(s) Abejera(s) [20]. The zone contains several sacred places, burial caves, and petroglyph sites placed on the summits of various roques. However, La Abejera is distinguished for three specific qualities, which make it directly comparable to the Yeje precinct: first, the visibility of the very top of Teide over the otherwise virtually flat mountanous northern horizon; second the presence of ritual basins and channels; and third, the presence of another horizontal circular radiate petroglyph, which is shown in Figure 3. This second "solar" glyph is quite small and, unfortunately, has been broken, possibly following a breakage in one of the radii, which have been numbered from 1 to 4. Radii 1 and 2 seem to bear no direct astronomical justification. Instead, they rather point in the general direction of the distant mountain of Teide and the impressive, 600 m high, Roque de Vento, where another engraving station is found [21]. However, it was most exciting to find that radii 3 and 4 pointed in the general directions of sunset for summer solstice ($\Pi_{\odot}$, over Risco Bisechi where another excellent petroglyph station had been found) and winter solstice ($\pi_{\odot}$, over La Abejera peak itself), respectively.

This phenomenology may seem irrelevant in itself, since the radii could have been marking sacred peaks and, in this case, any astronomy would be fortuitous. However, it is worth noting that an observer facing east would notice at close-up the presence of the verge of mountains closing the Valley of San Lorenzo, and behind it the large volcanic crater of Montaña Gorda as a distant point (see Figure 4). More important indeed, at that point of the verge, another sanctuary can be found. This is at the southern slope of Montaña Cambados, again formed by ritual basins and channels. Additionally, Teide is clearly viewed from the place and, most importantly, the archaeological context is completed by the only case of libyc alphabet inscriptions ever found in Tenerife [22]. The visibility of these prominent, distant points might have provided another reason to establish the sanctuary on the NE slope of La Abejera, since the summer solstice sunrise, seen from there, occurs exactly over Montaña Gorda and the sanctuary of Cambados, as demonstrated in Fig. 4.

From all these pieces of evidence, it follows that Montaña Gorda (as a distant foresight), and the sanctuaries of Cambados and La Abejera seem to be aligned following a solstitial line ($\pi_{\odot}$ to $\Sigma_{\odot}$). This impression is strengthened by the fact that two extra engraving stations are found, in the same solstitial line, at Roque

del Malpaso, three kilometres southwest of La Abejera and at Montaña Cabuquero, between La Abejera and Cambados. We are hence confident about the possibility that La Abejera might be the centre of a set of sanctuaries and engraving stations related to sunrise (e.g. Cambados, Cabuquero) and sunset (e.g. Bisechi) at the summer solstice.

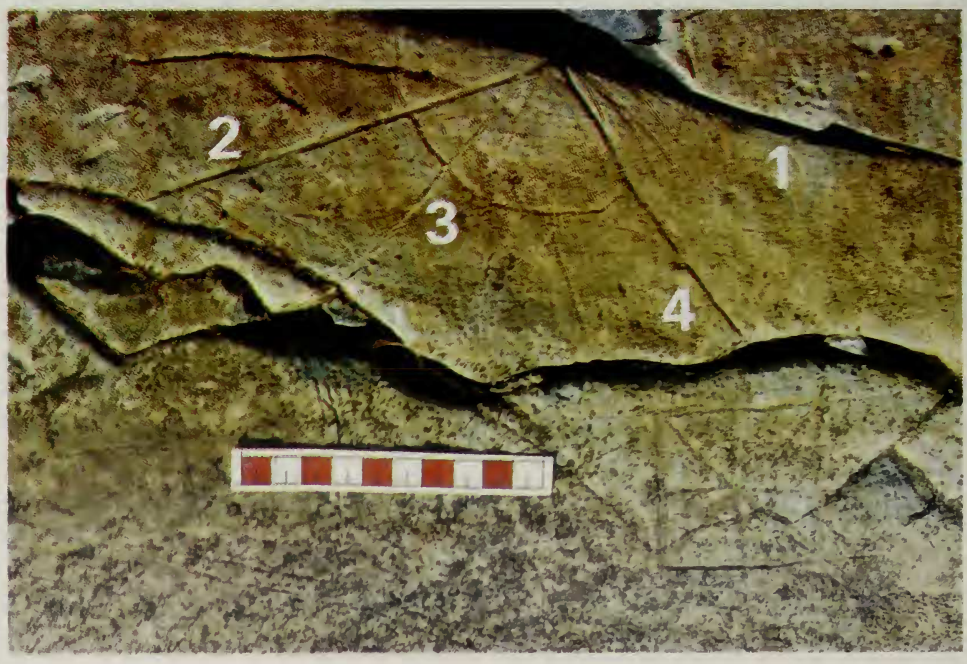

Fig. 3. Another horizontal circular radiate petroglyph can be found in an aboriginal sanctuary located on the north-eastern slope of Roque de las Abejeras (Valley of San Lorenzo). It is smaller and less impressive than that at Yeje. Indeed, it has been broken, having lost its original eastern (up) section. However, both its location –within a similar archaeological context (caves, channels, basins, etc...)– and a fairly atracttive and clean horizon make La Abejera a very interesting component of our study. The petroglyph is located at a point where the summit of Teide volcano is seen behind the, 2600 m high, mountain range which lies towards the north (this direction was marked by the radius followed by the fracture of the rock, i.e. radius 1). Another sacred mountain (a ceremonial precinct is found at the top), the Roque of Vento, is signaled by radius 2. The remaining radii, 3 and 4, point towards the general direction of sunset in the summer ($\Pi_{\odot}$) and the winter ($\pi_{\odot}$) solstices, respectively.

Fig. 4. Rising of the planet Mars, over the sanctuary of Cambados (marked by an arrow sign) and the distant foresight of Montaña Gorda, on December 5, 1992, at a declination of 23° 26'. Consequently, the trajectory followed by the planet mimics that of the summer solstice Sun, as seen from the "solar" glyph at La Abejera.

3.3. Almogaren at Roque Bentayga (Gran Canaria).

The impressive Roque Bentayga rises to 1412 m. in the middle of the huge (up to 9 km in diameter) volcanic caldera of Tejeda, in the heart of the island of Gran Canaria. The archaeological context of Bentayga is very rich, with the presence of defensive walls, artificial caves, for both living and burial, written inscriptions, petroglyph sites and, finally, on the south-east face of the peak the almogaren. Figures 5 and 6 present a plan and a snapshot of the precinct, respectively. The almogaren is surrounded by cliffs on three sides (NE,SE and SW). Consequently, the astronomical horizon mostly comprises the distant, and fairly attractive rim of the caldera, with peaks rising above 1500 m (Moriscos -1771 m-, Las Arenas -1609 m-, Las Nieves -the highest point of the island at 1949 m-, Roque Nublo -1813 m-, etc...). There are, however, some important exceptions towards the NW, hidden by the extremely steep slope of the Roque Bentayga itself (see Fig. 5), and at several degrees to the SE, hidden by some components of the almogaren itself (see Fig. 5 and 6).

Once more, a horizontal circular engraved symbol (**s**) is located at what has been considered as the centre of the sanctuary [23]. From that point, the eastern horizon is fairly attractive with several lines of sight which seem to be intimately related to important astronomical events (see Fig. 5 and 6). For example, we discovered that an observer located at **s** facing **H**, would have been able to appreciate, through window **v**, the rising of the morning Sun at the Equinoxes. Considering that the daily variation of declination of the Sun is fairly large when it crosses the celestial equator ($d\delta/dt$ of 23' *per* day), this phenomenon would have permited, under clear atmospheric conditions, to predict and/or to observe the Equinox with an error no larger than about one day. Moreover, in Figure 7 we show the star Fomalhaut (α PsA) crossing Roque Nublo on its ascending trajectory, when seen from any of the main platforms of the almogaren. The important fact is not the rise of Fomalhaut itself, but rather that this star currently has a declination of -29°.6, which is precisely the minimum possible declination of the Moon, as seen from Gran Canaria (-48' correction for parallax), but for an epoch close to 400 A.D. (the required -12' extra can be appointed to ϵ variability). It is worth noting that Roque Nublo is some 3100 m distant, with an apparent diameter of 35' when observed from Bentayga. Consequently, for a certain epoch, part of the disk of the post-summer-solstice full-Moon would have first risen slightly to the bottom left of the monolith; shortly thereafter it would have been completely obscured by the Roque, and it would have finally appeared, in its entirety, at the top right-hand corner. Thus, after each 19th year in the node precesion cycle, aproximately, this appealing phenomenon may have been observed by ancient Canarian "astronomers" (due to a lower value

of ϵ, it is no longer visible today). This possibility is seemingly reinforced by the fact that, for the same epoch, the moonrise at minor southern lunastice would have been observable through window **w** over Las Nieves, as seen from the very centre of the enclosure **s**. At this point, we feel obliged to pose the question: have we enough evidence to justify the use of the almogaren as an astronomical observing precinct, at the epoch 400 A.D.? We have found that the answer could be in the affirmative, with a reasonable degree of confidence. Within the sight of the Bentayga there are two important archaeological settlements, the troglodyte village of Cuevas del Rey (only two kilometres away), and the fortified rock-carved granary of Acusa. The ^{14}C method yields dates of 290±60 A.D. for the former, and 435±45 A.D. and 575±60 for the latter [24], thus seemingly supporting our hypothesis. Not so obvious, however, is the possibility of the place being used as an eclipse predictor. Discussion of this point in connection to other sacred enclosures throughout the world are found in the literature [25], and an eclipse observation, registered by the ancient Canarians, has been suggested in a recent work [26].

On the other side, Teide Peak (in the neighbouring island of Tenerife) is seen conspicously from some sectors of Bentayga just behind the mountain of Altavista. In this sense, it is worth noting that the first New Moon after or simultaneous to the summer solstice (i.e. the corresponding to the full-moon we were discussing previously) would have been seen (and still is) setting behind this important peak throught the 19 year cycle. In fact, the average azimuth along that cycle is exactly the azimuth of the very summit (288°.5).

Additionally, other astronomical events –such as winter solstice sunrise and sunset, moonsets, normal and heliacal stellar risings and settings, etc...– have been investigated. However, none of these is strongly suggested by any other astroarchaeological evidence. This is not surprising since the hypothetical observing point, of all those possible throughout the fortress, might have been chosen as the only one from which it was possible to observe the Moon phenomenon behind Roque Nublo, a truly paradigmatic combination of an artificial backsight and a natural foresight, as those found in megalithic "observatories" in the British Isles. The windows –possibly rock-carved– were probably built later on in order to provide other astronomical observables such as the Equinox.

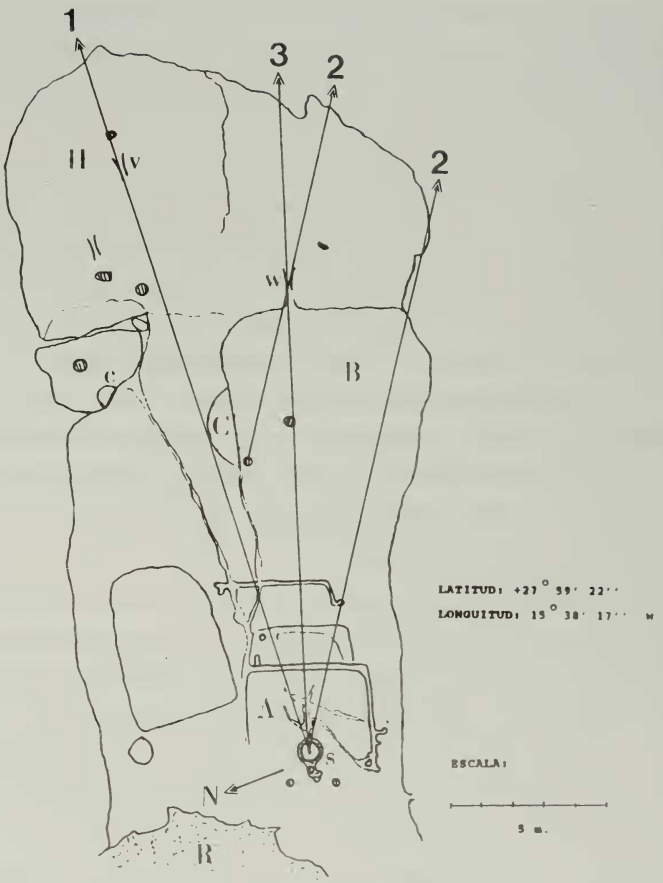

Fig. 5. Schematic plan of the central part of the almogaren located on the east slope of the impressive Roque Bentayga, in the very centre of the island of Gran Canaria. The almogaren basically consists of a major plane platform (**A**), carved on the rock-bed, with a circular glyph in its centre (**s**), a secondary platform (**B**), a couple of artificial caves (**C and c**), a possibly carved window (**w**), and a natural (?) rocky peak (**H**) with another window, perhaps artificial, (**v**) and a carved pole-host (**h**) behind it. Several, non-randomly distributed, ritual basins are found throughout the place. The sacred enclosure seemed to be designed for observing events occurring over the Eastern horizon. The very steep slope of the Roque itself (**R**) hides from view most of the West horizon, as seen from the almogaren. Directions **1**, **2** and **3** mark the principal astronomical alignments: equinox sunrise, moonrises at mayor and minor lunastices, respectively.

Fig. 6. The Eastern horizon as seen from the central platform **A** of the Bentayga almogaren. All the dominant features, with probable archaeoastronomical significance, are captured in the picture: the rocky peak **H** and window **v** to the left, platform **B** and window **w** with Las Nieves at the very centre and, finally, Roque Nublo to the right.

Fig. 7. Rising of Fomalhaut (αPsA) behind the outstanding Roque Nublo, as seen from either the "astral" symbol (**s**), at platform **A**, or across window **w** and platform **B**. αPsA presently has a declination of -29°.6. The trajectory followed in the photograph by the star mimics that followed by the full-moon, in its maximum southern excursion (major standstill with negative declination), for the years around 400 A.D. (see text for further discussion).

3.4. The Sanctuaries at Cuatro Puertas (Gran Canaria).

Cuatro Puertas is the name of an archaeological settlement –one of the richest in Canary Islands– located on and near the top of a 319 m high hill in the northeast of Gran Canaria. An impressive troglodyte artificial village, resembling those of Capadocia, lies on the southern slope of the hill. Figure 8 shows the frontage of an artificial sanctuary cave [27], with four sculpted entrances (the reason for the name Cuatro Puertas, Spanish for "four doors") located on the opposite slope, facing true north over an artificial terrace crossed by numerous smallpans and basins. The inside of this sanctuary is carved in the volcanic toba, producing an almost rectangular dwelling with no significant features but a secondary cave (a granary?) in the SW corner and a bench (an altar?) in the SE one. Finally, another almogarén is found on the mountain top. As in Bentayga, this is also deeply sculpted on the volcanic ground and comprises several ritual basins, smallpans and channels carved on the floor, the largest one (3 m diametre) having the shape of a very sharp lunar crescent. The precinct is closed on three sides (west, north and east) by carved walls in which some artificial windows, knocks and petroglyphs have been sculpted. Figure 9 shows the most conspicuous of those petroglyphs which has been identified with a set of lunar crescents, amongst other interpretations. The largest artificial window lies in the opposite direction, opening to the east, so that the flat sea horizon can be seen from the petroglyph through that window.

It is not an easy task to explain the presence, within a single settlement, of so many different and strange components and this has been puzzling archaeologists since the settlement was firstly described a century ago, without finding a unique satisfactory response [28]. However, we have discovered that several of the intriguing components of both the almogaren and the sanctuary cave would have a sensible reason to exist and an apparent use within an archaeoastronomical context. With this explanation in mind, the most significant phenomenology is related to the summer solstice, when three different redundant hierophanies take place, a couple at sunrise and one at sunset. On the one hand, a very beautiful phenomenon occurs in the almogaren at summer solstice sunrise (see Fig.9), whilst, simultaneously, a spectacular hierophany is observable from the inside of the sanctuary cave. An early observer would see a very thin (a few arcminutes) knife of light penetrating the cave through the second entrance and illuminating the back wall for a few minutes, the solstice being the only time of the year when sunlight reaches the interior of the cave at sunrise. On the other hand, Figure 10 shows the phenomenon produced at the interior of the sanctuary cave but at sunset instead of sunrise.

Considering the orientation, shape and size of the entrances, these might

have been designed with an astronomical scope in mind, i.e. that the solar light went into the sanctuary only at the time of the summer solstice. This would be the single reasonable explanation offered so far for the northern orientation and the peculiar distribution of this charismatic monument. Several other astronomical possibilities (equinoxes, winter solstice, lunar standstills, etc) were also investigated. Although there are scarce evidences of a relation with the equinox (both the almogarén and the sanctuary frontage, including the terrace, are east-west oriented), these are largely darkened by the solstitial phenomena.

If in the previous sections of this paper we tried to justify the location of the sanctuaries at Yeje, La Abejera and Bentayga on the basis of their possible nature as backsights of conspicuous astronomical phenomena taking place in distant and natural foresights, this is no longer the case in Cuatro Puertas. The archaeoastronomical elements described in Cuatro Puertas are special since they are all artificial, i.e. all the components involved in the solstitial hierophanies are man made . Consequently, astronomy need not be claimed as the final scope in the selection of the site, which instead may have been chosen for more prosaic motives (e.g. defense, hours of sunshine in the main village, etc).

Fig. 8. The Northern slope sanctuary cave at Cuatro Puertas (the one naming the complex). The almogaren lies at the top of the hill and its verge can be seen in the top-left corner of the image.

Fig. 9. Summer solstice sunrise hierophany at the almogaren of Cuatro Puertas. Two artificial elements, a window and a knock, engraved in the NE wall of the precinct, produce a very distinct shadow on an engraving in the western wall. The successive images show the evolution of the phenomenon from sunrise till some 15 minutes later when the knock shadow path abandons the northern border of the engraving. Simultaneously, another hierophany is produced at the sanctuary cave (see text for further explanation).

Fig. 10. Summer solstice sunset hierophany at the northern sanctuary cave of Cuatro Puertas. Two narrow paths of light penetrate the cave, through two of the entrances (third and fourth from the east), only a few days before and after summer solstice. On the day of the solstice, one of the paths, shaped like an arrow, hits an sculpted bench (an altar?) in the SE corner of the sanctuary in such a way that the last solar rays paradigmatically lighten a smallpan (C) engraved over the altar.

4. DISCUSSION AND CONCLUSIONS.

One of the primeval objectives of this study had been to establish which calendar, if any, was in use in the islands of Tenerife and Gran Canaria, during pre-hispanic times.

In Tenerife, the chroniclers indicate the celebration of the harvest festivals during August [29,30]. That period was termed (Begnesmet) having suggested a meaning of "second lunation" (see sect. 2). This would imply that the first month of the year might have been around July, and probably that, in fact, the new year would have been marked by the new-moon which follows the summer solstice, as in several other cultures on the Mediterranean. From the archaeoastronomical evidence avaliable, it is quite clear that the importance of the summer solstice was ubiquitous in Tenerife (not only in pre-hispanic times, but also after the conquest [31,32]) and, on the other hand, at Yeje, we have a marginal indication of a possible Begnesmet (August) full-moon hierophany behind the Peak of Teide.

The importance of June 24th, which is currently celebrated (still exists the pleasant ancient custom of bathing the goats in the sea on that dates), and of August 15th (feast of Candelaria, the patroness Virgin of the island) reinforce the arguments in favour of the summer solstice and the second subsequent new- or full-moon, as the major reference points of the guanche calendar. The system would probably have been somewhat loose, i.e. alternating years of 12 and 13 lunar months in a random fashion, since no evidence of an arbitrary extra month, or a cyclic system, have been found either in the ethnographic, or in the archaeological records.

With respect to Gran Canaria, we have chronicler Sedeño's information about the vernal Equinox and the fourth moon festivals at the end of June [33] and, if historian Tomás Marín de Cubas' [34] unique reference to summer solstice (he does not refer to the equinox) is taken as a attempt to express in concrete terms previous confusing information, the agreement between the chroniclers and the archaeoastronomical evidences might be considered adequate. Both agree on the importance of the (vernal) Equinox as a significant fixed point for the Canarian system of time keeping, probably serving either as the new year eve itself or as the zero point for counting the months, starting with the next new-moon. Consequently, the fourth lunar month, starting at the end of June or the beginning of July, and perfectly anticipated by the summer solstice, would have marked the harvest festivals.

At Roque Bentayga, the post summer solstice New Moon would have been seen setting behind Teide Peak whilst, at the same time, the southern minor and major rising lunastices seem to be marked at the eastern horizon. These would

have always encompassed the point of rising of the subsequent full-moon (i.e that following the summer solstice), belonging to the 4th lunar month, thus supporting the importance of that epoch, paradigmatically marked by the reiterative solstice hierophanies visible at Cuatro Puertas and other solstitial phenomena produced at other sites of the island [35]. Consequently, the vernal Equinox, the summer solstice and the fourth new- and/or full-moon would have acted as the reference points of the ancient Canarian time keeping system. This calendar would have been also luni-solar, as in Tenerife. However, in this case, the Roque Nublo lunar phenomenon strongly suggests some kind of knowledge of the 19 year luni-solar conjunction cycle. Whether this knowledge was, in fact, used to produce a more sophisticated calendar cycle, similar to the Methonic, for example, instead of a looser year system, is difficult to infer from the evidences available now.

To conclude, it is worth noting that, in the case of the Roque Bentayga, we have, for the first time in the Canary Islands, a possibly independent archaeoastronomical confirmation of the epoch when a certain aboriginal ceremonial centre was built and/or in use. The lunar phenomenon would have started to be seen, from the almogaren, well before the beginning of the Christian era; it would have had its maximum complete lunar ocultation at the beginning of the Vth century A.D., and would have been observable for the last time shortly after the year 600 A.D. These dates agree perfectly with the extreme values, yielded by Carbon 14, for the occupation of neighbouring settlements, i.e. the interval between 230 and 640 A.D. At the time of the castillian conquest, 8 centuries later, Bentayga was used mainly as a fortress, as stressed in the chronicles, whilst its possible time keeping (i.e. astronomical) utility had apparently been forgotten.

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